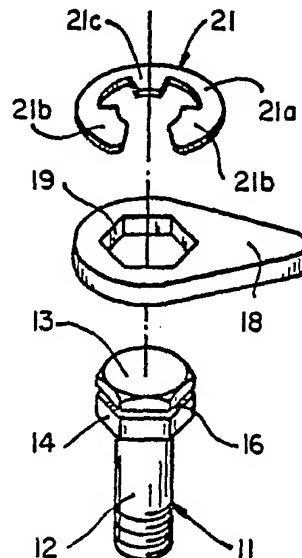




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/US86/01428</p> <p>(22) International Filing Date: 3 July 1986 (03.07.86)</p> <p>(31) Priority Application Number: 755,907</p> <p>(32) Priority Date: 17 July 1985 (17.07.85)</p> <p>(33) Priority Country: US</p> <p>(71)(72) Applicant and Inventor: BENNETT, Bruce, Allan [US/US]; 15 Chestnut Street, San Rafael, CA 94901 (US).</p> <p>(74) Agents: WRIGHT, Edward, S. et al.; Flehr, Hohbach, Test, Albritton & Herbert, Four Embarcadero Center, Suite 3400, San Francisco, CA 94111-4187 (US).</p> <p>(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BG, BR, CH, CH (European patent), DE, DE (European patent), DK, FI, FR (European patent), GB, GB (European patent),</p>	<p>HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC, MG, MW, NL, NL (European patent), NO, RO, SD, SE, SE (European patent), SU.</p> <p>Published <i>With international search report.</i></p>	

(54) Title: LOCKING FASTENER



(57) Abstract

Locking fastener comprising a threaded part such as a bolt (13) or nut (28) and a locking plate (18) which fits over the bolt or nut and is prevented from rotation by engagement with a stationary object such as protrusion on the part to be secured. The locking plate has an opening (19) with a contour which mates with the outer contour of the fastener to prevent rotation of the fastener, and the plate is retained on the fastener by a retainer (21) mounted in a groove (16, 29) formed in the fastener itself.

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LOCKING FASTENER

This invention pertains generally to threaded fasteners such as bolts and nuts, and more particularly to a fastener which is secured against movement from a set
5 position.

Heretofore, a number of techniques have been employed to secure bolts and nuts and prevent them from working loose when subjected to vibration. Such techniques have included the use of lock washers, locking fluids, various
10 mechanical restraints, and even welding the fasteners in place. All of these techniques have certain limitations and disadvantages. Some are too complicated for practical use, some are ineffective, and some can be employed only in certain specific applications. With many of these
15 techniques, it is not possible to remove the fastener once it has been secured without destroying either the locking device or the fastener itself.

It is in general an object of the invention to provide a new and improved fastener which is secured against
20 movement from a set position.

Another object of the invention is to provide a fastener of the above character which overcomes the limitations and disadvantages of locking fasteners heretofore provided.

Another object of the invention is to provide a fastener of the above character which is easily installed and removed, reliable and suitable for use in a wide variety of applications.

5 These and other objects are achieved in accordance with the invention by providing a threaded fastener such as a bolt or nut with a locking plate which fits over the fastener and is prevented from rotation by engagement with a stationary object such as a protrusion on the part to be
10 secured. The plate has an opening with a contour which mates with the outer contour of the fastener to prevent rotation of the fastener, and the plate is retained on the fastener by a retainer mounted in a groove formed in the fastener itself.

15 Figure 1 is an exploded isometric view of one embodiment of a locking fastener according to the invention.

Figure 2 is a cross-sectional view of the fastener of Figure 1 in its assembled and operative position.

Figure 3 is an isometric view, partly broken away, of a
20 second embodiment of a locking fastener according to the invention.

Figures 4 and 5 are top plan views of additional embodiments of locking plates for use in the fastener of the invention.

25 As illustrated in Figure 1, the locking fastener comprises a threaded fastener or part in the form of a bolt 11 which has a threaded shank portion 12 and a hexagonal head portion 13. The head portion has a non-circular contour in plan view, with flat surfaces 14 arranged in opposing
30 pairs for engagement by a wrench. A peripheral groove 16 is formed in the head portion toward the outer end of the head portion and opens through the flat surfaces.

A locking plate 18 with a hexagonal opening 19 fits over the head portion of the bolt, with the head portion extending through the hexagonal opening. The size and shape of the opening are such that the head portion of the bolt can pass freely through the opening in an axial direction, but it cannot rotate within the opening. The plate has a generally teardrop shape and is adapted to abut against a stationary object such as a protrusion on the part to be held, thus preventing the bolt from rotating in the direction which would cause it to loosen.

The locking plate is retained axially on the bolt by a retainer clip 21 mounted in groove 16, with a diameter greater than the diameter of opening 19. In one preferred embodiment, the retainer clip is a spring clip or a generally C-shaped clip of resilient material which grips the bolt head securely yet is easily installed and removed. Alternatively, the retainer can consist of a pin which extends through a hole in the bolt head and projects laterally from the sides of the head to retain the plate.

In Figure 2, the fastener is illustrated in connection with a workpiece 23 which has a protrusion 24 projecting therefrom. The bolt is inserted into a hole 25 in the workpiece and tightened in the conventional manner with a wrench which engages the head portion of the bolt. Thereafter, locking plate 18 is placed over the head portion of the bolt and positioned to abut against protrusion 24 in the event that the bolt should begin to loosen. Retainer clip 21 is inserted in groove 16, and the locking plate is thus retained between the workpiece and the retainer clip.

The embodiment of Figure 3 is similar to the embodiment of Figure 1, and like reference designate corresponding elements in the two embodiments. In the embodiment of Figure 3, however, the fastener is a nut 26 having a hexagonal body with an internal thread 27 and external

flat surfaces 28 arranged in opposite pairs for engagement with a wrench. Retainer clip 21 is mounted in a groove 29 which opens through surfaces 28 toward one end of the nut. Locking plate 18 fits over the nut and prevents rotation
5 of the nut in the same manner that it prevents rotation of the bolt in the embodiment of Figure 1.

The outer end surface 30 of the nut adjacent to groove 29 is bevelled or tapered to facilitate installation of the
10 surface, the clip opens and snaps into groove 29. This enables the retainer to be installed in an axial direction and permits the device to be employed in places where there is little or no access to the sides of the fastener. The head of a bolt or other fastener can be bevelled or
15 tapered in a similar manner.

The locking plate 31 illustrated in Figure 4 is similar to locking plate 18 except it has a 12-point opening 32 instead of a hexagonal opening. The opening is oriented to provide an offset of 7.5% between its axis of symmetry
20 33 and the centerline 34 of the plate. The plate can be positioned with either side up, and with the offset it can be oriented in any one of 24 different positions about the bolt or nut. The hexagonal opening 19 in plate 18 can be offset in a similar manner to provide 6 additional
25 positions when that plate is turned over.

The locking plate can be of any suitable size and shape for a particular application, and Figure 5 illustrates an embodiment which is particularly suitable for securing the nuts or bolts which hold an exhaust header on an engine.
30 This plate, designated by the reference numeral 36, has a 12-point opening 37 and an arcuate side edge 38 which mates with the header pipe to prevent the plate from turning.

While the invention has been described with specific reference to bolts and nuts, it can be employed with lag screws and other threaded fasteners as well. The locking plate can be secured against rotation by abutting engagement with any nearby stationary object such as a protrusion on the part being held, another bolt or nut, or a dowel pin.

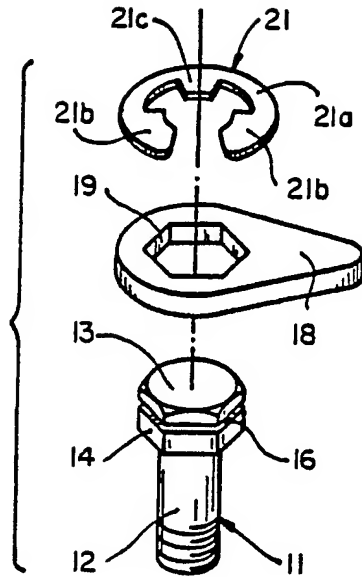
The invention has a number of important features and advantages. It is easily installed and removed, and it can be employed in both large and small spaces. It can be tightened with any type of wrench employed with conventional nuts and bolts in a similar space. No special tools are required to install and remove the locking plate and retainer clip. The clip and plate can be removed and reinstalled repeatedly without damage to either these parts or to the fastener itself, and without any loss of security. The condition of the parts can be observed visually, and the parts are easily removed and tested if desired.

It is apparent from the foregoing that a new and improved locking fastener has been provided. While only certain presently preferred embodiments have been described in detail, as will be apparent to those familiar with the art, certain changes and modifications can be made without departing from the scope of the invention as defined by the following claims.

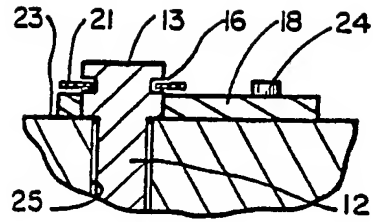
1. A fastener comprising a threaded part having an external surface of non-circular contour, a locking plate having an opening in which the surface of non-circular contour is received to prevent rotation of the threaded part, a groove formed in the surface of non-circular contour, and a removable resilient retainer clip mounted in the groove to retain the locking plate on the threaded part with the surface of non-circular contour being received in the opening to prevent rotation of the threaded part.
2. The fastener of Claim 1 wherein the threaded part is a bolt.
3. The fastener of Claim 1 wherein the threaded part is a nut.
4. The fastener of Claim 1 wherein the threaded part has a tapered end surface adjacent to the groove, and the resilient retainer clip expands circumferentially and snaps into the groove when pushed onto the threaded part over the tapered surface.
5. A fastener comprising a bolt having a head portion with opposing flat surfaces for engagement by a wrench, a locking plate which is constrained against rotation and has an opening in which the head portion of the bolt is received to prevent rotation of the bolt, an outwardly facing peripheral groove which opens through the flat surfaces of the head portion, and a resilient retainer clip removably mounted in the groove to retain the locking plate on the bolt.

6. A fastener comprising a nut having a pair of opposing flat surfaces engageable with a wrench and a peripheral groove opening through the flat surfaces, a locking plate which is constrained against rotation and has an opening
5 in which the nut is received to prevent rotation of the nut, and a resilient retainer clip removably mounted in the groove to retain the locking plate on the nut.

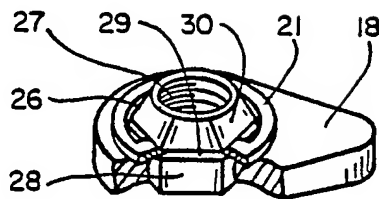
7. The fastener of Claim 6 wherein the nut has a tapered end surface adjacent to the groove, and the resilient clip expands circumferentially and snaps into the groove when pushed onto the nut over the tapered surface.



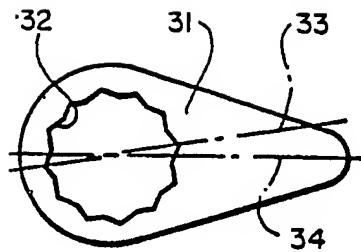
FIG_1



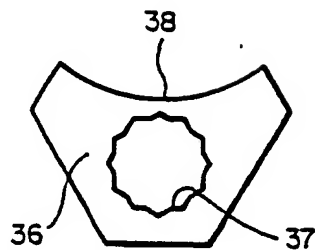
FIG_2



FIG_3



FIG_4



FIG_5

INTERNATIONAL SEARCH REPORT

International Application No PCT/US 86/01428

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ³ According to International Patent Classification (IPC) or to both National Classification and IPC Int Cl. (4): F16B 21/18; F16B 39/10 U.S. Cl. 411/120, 121, 353, 517																																									
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched ⁴</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 30%; border-bottom: 1px solid black;">Classification System</th> <th style="border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="height: 40px; vertical-align: top; padding: 5px;">U.S.</td> <td style="padding: 5px;">411/90-100, 116-124, 353, 372, 517</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵</div>			Classification System	Classification Symbols	U.S.	411/90-100, 116-124, 353, 372, 517																																			
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴ <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category [*]</th> <th style="border-bottom: 1px solid black;">Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷</th> <th style="border-bottom: 1px solid black;">Relevant to Claim No. ¹⁸</th> </tr> <tr><td style="text-align: center;">Y</td><td>US, A, 3,875,985 (OKUDA) 08 April 1975,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">Y</td><td>US, A, 1,209,460 (LOWE) 19 December 1916,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">Y</td><td>FR, A, 637,364 (FRELIN) 28 January 1928,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">Y</td><td>DE, C, 971,597 (WISCHMANN) 26 February 1959,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">Y</td><td>US, A, 274,188 (GROVES) 20 March 1883,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">A</td><td>US, A, 2,741,290 (WOLFE) 10 April 1956,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">A</td><td>GB, A, 468,629 (HARLEY) 05 July 1937,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">A</td><td>DE, B1, 1,143,364 (KUNZ) 07 February 1963,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">A</td><td>FR, B2, 15,467 (GRIMAULT) 03 May 1912,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">A</td><td>BE, B7, 517,186 (COBENA) 14 February 1953,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">A</td><td>US, A, 1,088,515 (BAZIN) 24 February 1914,</td><td style="text-align: center;">1-7</td></tr> <tr><td style="text-align: center;">A</td><td>US, A, 3,493,026 (DONOFRIO) 16 July 1968,</td><td style="text-align: center;">1-7</td></tr> </table>			Category [*]	Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸	Y	US, A, 3,875,985 (OKUDA) 08 April 1975,	1-7	Y	US, A, 1,209,460 (LOWE) 19 December 1916,	1-7	Y	FR, A, 637,364 (FRELIN) 28 January 1928,	1-7	Y	DE, C, 971,597 (WISCHMANN) 26 February 1959,	1-7	Y	US, A, 274,188 (GROVES) 20 March 1883,	1-7	A	US, A, 2,741,290 (WOLFE) 10 April 1956,	1-7	A	GB, A, 468,629 (HARLEY) 05 July 1937,	1-7	A	DE, B1, 1,143,364 (KUNZ) 07 February 1963,	1-7	A	FR, B2, 15,467 (GRIMAULT) 03 May 1912,	1-7	A	BE, B7, 517,186 (COBENA) 14 February 1953,	1-7	A	US, A, 1,088,515 (BAZIN) 24 February 1914,	1-7	A	US, A, 3,493,026 (DONOFRIO) 16 July 1968,	1-7
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>[*] Special categories of cited documents: ¹⁵</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&" document member of the same patent family</p> </div> </div>																																									
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of the Actual Completion of the International Search ²</td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;">Date of Mailing of this International Search Report ²</td> </tr> <tr> <td style="padding: 5px;">29 July 1986</td> <td style="text-align: center; padding: 5px;">19 AUG 1986</td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;">International Searching Authority ¹</td> <td style="border-bottom: 1px solid black; padding: 5px;">Signature of Authorized Officer ²⁰</td> </tr> <tr> <td style="padding: 5px;">ISA/US</td> <td style="text-align: center; padding: 5px;"> Thomas J. Holko </td> </tr> </table>			Date of the Actual Completion of the International Search ²	Date of Mailing of this International Search Report ²	29 July 1986	19 AUG 1986	International Searching Authority ¹	Signature of Authorized Officer ²⁰	ISA/US	 Thomas J. Holko																															
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FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	US, A, 4,284,114 (KORENOBU) 18 August 1981,	1-7
A	FR, A, 583,366 (BLACHE) 29 October 1924,	1-7

V. ☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. ☐ Claim numbers because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. ☐ Claim numbers because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. ☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. ☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

- ☐ The additional search fees were accompanied by applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.